61-58.2
Groundwater Sources and Treatment

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A. Applicability.

This regulation applies to all new construction and all expansions or modifications of existing public water systems. If the Department can reasonably demonstrate that safe delivery of potable water to the public is jeopardized, a system may have to upgrade its existing facilities in order for an expansion or modification to meet the requirements of this regulation. This regulation prescribes minimum design standards for the construction of groundwater sources and treatment facilities.

B. Groundwater Development.

All wells must be constructed by a certified well driller.

(1) Quantity -

(a) A minimum of two (2) independent sources of groundwater shall be provided for all community water systems serving fifty (50) or more taps or one hundred fifty (150) or more people. Systems with an additional source (Surface Water Plant or Master Meter) will not be required to have two groundwater sources.

(b) The total developed groundwater source capacity shall equal or exceed the design maximum day demand without pumping more than sixteen (16) hours a day. With the largest producing well out of service, the capacity of the remaining well(s) pumping twenty- four (24) hours a day shall equal or exceed the design maximum daily demand, except those systems requiring only one well. The capacity from an additional source (Surface Water Plant or Master Meter) will be included in the quantity analysis. However, emergency and stand-by wells will not be included in the quantity analysis.

(2) Quality - Where the water quality does not meet the drinking water standards established in R.61-58.5, appropriate treatment designed in accordance with R.61-58.2 shall be provided.

(3) Site Considerations -

(a) Location -

(i) The location of the public well shall be at least one hundred (100) feet from all potential pollution sources except where the professional engineer or professional geologist can justify a lesser distance based in part on hydrogeological conditions or special well construction techniques or where the pollution source is designed in such a manner as to prevent the release of contaminants to the environment. A greater pollution free radius shall be required where water from water table aquifers will be used. A Wellhead Protection Area Inventory must be performed based on the location and expected yield of the proposed well.

(ii) The well location shall be at least fifty (50) feet from all surface water bodies including drainage ditches. The site must be such that the wellhead can be protected above the one hundred (100) year flood plain. Special construction techniques may be required by the Department in any area which is generally subject to flooding and the professional engineer must demonstrate to the satisfaction of the Department that the site selected is the best available. No well(s) shall be constructed in such proximity to existing wells as to cause unwarranted well interference.

(b) Easement - Once the pollution free radius is established according to R.61- 58.2(B)(3)(a), an appropriate easement, ownership or deed restriction to ensure the required pollution-free radius shall be filed at the county courthouse. A copy of the deed must be submitted to the Department prior to placing the

well into operation. If a right-of- way easement is needed to maintain access to the well, such an easement shall be filed at the county courthouse and a copy submitted to the Department prior to placing the well into operation.

(c) Special Considerations - Wells located within two hundred (200) feet of a body of water, or constructed such that water is being drawn from less than fifty (50) feet in depth, or constructed such that the filter material extends to less than fifty (50) feet below grade, must conduct special monitoring required in R.61-58.2(B)(14)(c). This monitoring must be conducted within one year of receiving the permit to operate. If the well is found to be under the direct influence of surface water, treatment must be added and monitoring conducted in accordance with the requirements of R.61-58.10, Filtration and Disinfection.

(4) All materials and products installed in a public water system after December 31, 1995, which comes into direct contact with drinking water during the treatment, storage, transmission or distribution of the water, shall be certified as meeting the specifications of the American National Standard Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

(5) Drilling and Sampling -

(a) Driller's log - A driller's log shall be completed for each well and shall include a depth reference point, the depth of each formation change, a description of each forma- tion including color, mineralogy, rock type, grain size, and any other observations which may have a bearing on the final construction of the well. Special attention is required in the case of Type I wells in that the log shall denote the depth, thickness, and approximate flow of each fracture or fracture zone as measured by discharge during air circulation hammer/rotary drilling. The Department must be provided two (2) copies of the driller's log prior to the construction of the pumping, treatment or distribution facilities associated with the well or with the engineer's certification letter if the project is permitted in one step.

(b) Geophysical/Mechanical logs - Where required by the Department, two (2) copies shall be provided to the Department prior to the construction of the pumping, treatment or distribution facilities associated with the well or with the engineer's certification letter if the project is permitted in one step.

(c) Penetration rate log - Where required by the Department, two (2) copies shall be provided to the Department prior to the construction of the pumping, treatment or distribution facilities associated with the well or with the engineer's certification letter if the project is permitted in one step.

(d) Sieve Analysis For Type II and III Wells - Where required by the Department, two (2) copies of sieve analysis results shall be provided to the Department prior to the construction of the pumping, treatment or distribution facilities associated with the well or with the engineer's certification letter if the project is permitted in one step.

(e) Drilling fluid control program - Where drilling water is used, it shall contain no dangerous materials, shall be disinfected and shall meet the drinking water standards established in R.61-58.5. All other drilling fluids and additives used shall comply with recognized industry standards and practices for the construction of drinking water wells, and shall be applied and used as prescribed by the manufacturer. Toxic and/or dangerous substances shall not be added to drilling fluid. Non-potable surface or ground water shall not be used as a drilling fluid.

(6) Well Casing Selection and Installation -

(a) Casing selection - New casing which bears mill markings and which conform to standard specifications (ASTM A-53) for water well pipe shall be used. Thermoplastic casing and couplings which meet standard specifications (ASTM F-480) and which are approved by the National Sanitation Foundation may be used for Type II, III and IV wells which will not exceed three hundred (300) feet in depth. Unless specifically approved by the Department, thermoplastic casing shall not be used for Type I wells. No material containing more than eight (8) percent lead by weight shall be used in the completed well.

(b) Method of installation - The following methods shall be used:

Well	**Casing installed by**
Type I	Driving to refusal in firm bedrock. Where firm bedrock is encountered shallower than twenty (20) feet a minimum casing length of twenty (20) feet will be required.
Type II and III	Lowering the casing string in the pre-drilled hole so as not to damage any parts of the screen or casing.
Type IV	Driving into firm limestone where metal casing is used or by placing into firm limestone where thermoplastic casing is used.

(c) Method of joining - Casing lengths shall be joined in alignment and made water tight by an appropriate method for the material used such that the resulting joint shall have the same structural integrity as the casing. Threaded and coupled joints shall be API or equivalent and shall be firmly and securely seated. PVC solvent cement and bell end or coupled joints shall meet ASTM standard specifications.

(d) Sanitary protection of well - The well shall be protected at all times during construction. The casing shall be sealed with a suitable flanged, threaded, or welded cap or compression seal upon completion. The outside casing shall be sealed to, and centered in, a reinforced concrete pad having a minimum strength of two thousand (2000) pounds per square inch, a minimum radius of three (3) feet and a minimum thickness of four (4) inches. The concrete pad shall be constructed with a slope so that water will drain away from the casing. The top of the outside casing shall extend at least twelve (12) inches above the concrete pad. There shall be no openings in the casing wall below its top except for water level measurement access ports or vents. Such openings shall be sealed water tight prior to use of the well. Any well which is to be temporarily removed from service, or which is completed for a period of time prior to being placed in service, shall be capped with a watertight cap and protected from vandalism.

(e) Well identification plate - Every well shall be equipped immediately after completion of the drilling, and prior to issuance of a permit to operate with an identification plate.

(i) The identification plate shall be constructed of a durable, weatherproof, rustproof metal or equivalent material.

(ii) The identification plate shall be securely attached to the well casing or concrete pad around the casing where it is readily visible.

(iii) The identification plate shall be stamped with a permanent marking to show the following information:

(A) Drilling contractor and registration number;

(B) Date well completed;

(C) Total depth of well (in feet);

(D) Casing: Depth (in feet), Inside Diameter (in inches);

(E) Screened intervals (of screened wells);

(F) Filter-pack interval (of wells with artificial filter-pack);

(G) Yield expressed in gallons per minute (gpm), or specific capacity expressed in gallons per minute per foot of drawdown (gpm/ft.-dd);

(H) Static water level and date measured; and,

(I) Latitude and longitude (to the nearest second).

(7) Well Grouting - The Department shall be notified a minimum of three (3) days prior to the time of grouting.

(a) Grouting materials -All wells shall be grouted with a minimum of sand-cement, bentonite-cement mixture or neat cement. The sand-cement or neat cement mixture shall be composed of not more than two (2) parts by weight of sand to one (1) part of cement with not more than seven (7) gallons of clean water per bag (one cubic foot or 94 pounds) of cement. The bentonite-cement mixture shall be composed of three (3) to five (5) pounds of bentonite mixed with seven (7) gallons of clean water per bag (one cubic foot or 94 pounds) of cement.

(b) Method of installation of grout - Grout material shall be placed by tremie pipe, either by pouring or forced injection, after water or other drilling fluid has been circulated in the annular space sufficiently to clear all obstructions. There shall be a minimum annular space of three (3) inches for gravity feed and one and one-half (1.5) inches for forced injection between the outside surface of the casing and the formation. The minimum size tremie pipe shall be two (2) inches inside diameter for gravity feed and one (1) inch inside diameter for forced injection. When placing the grouting material, the tremie pipe shall be lowered to the bottom of the zone to be grouted and raised slowly as the grout material is introduced. The tremie pipe shall be kept full continuously from start to finish of the grouting procedure, with the discharge end of the tremie pipe being continuously submerged in the grout until the zone to be grouted is completely filled. The grout shall be allowed to properly cure before construction may be resumed.

More sophisticated methods of installation of grout may be used but care must be taken to ensure these are in accordance with standard procedures.

(c) Length of grout - The minimum length of grout for sanitary protection shall be:

Well	**Grouted from surface**
Type I	To at least fifty (50) feet or firm bedrock, whichever is less. However, where bedrock is encountered at less than twenty (20) feet, at least twenty (20) feet of casing shall be used and the entire length of the casing shall be grouted.
Type II and III	To fifty (50) feet or the first low permeability stratum (clay, marl, etc.), or to within ten (10) feet of the upper most screen when no low permeability stratum is encountered, whichever is greater.

Type IV	To fifty (50) feet or firm limestone or firm marl, whichever is less. However, where limestone or firm marl is encountered at less than twenty (20) feet, at least twenty (20) feet of casing shall be used and the entire length of the casing shall be grouted.

The Department may require an additional length of grout where warranted by site, geological and/or water quality conditions.

(d) Centralizers - For Well Types II and III centralizers shall be attached to the outer casing at the bottom of the upper zone to be grouted and at the top and bottom of other critical grouting points such as zones of unsuitable water quality as indicated by test hole information.

(8) Well Screens - This part is applicable to Well Types II and III only.

(a) Filter type selection - Where a non-homogeneous aquifer, having a uniformity coefficient less than three (3.0) and an effective grain size less than one tenth (0.1) inches is to be screened, an artificial filter shall be used as described in R.61-58.2(B)(9).

(b) Screen-type selection - The screen specified shall have controlled uniform slot size, have structural integrity, and be of a type which will allow a well entrance velocity which does not exceed six (6) feet per minute. The use of non-metallic screens will be reviewed on a case-by-case basis. The use of non-metallic screen settings below two hundred (200) feet will be allowed only when recommended by the manufacturer.

(c) Screen slot size - The screen slot size shall be based on sieve analysis, industry standards, and good engineering practice; and/or shall meet the sand content limits outlined in R.61-58.2(B)(11)(b).

(d) Screen length - Screen of sufficient length shall be installed to obtain an entrance velocity not to exceed six (6) feet per minute.

(e) Screen location - Screen settings located in unconfined water-table aquifers shall be approved only on a case-by-case basis where justification concerning pollution-free radius, treatment, etc. is provided.

(f) Method of screen installation - The screen shall be provided with such fittings as are necessary to seal the top tightly to the casing and to close the bottom, as defined in R.61-58.2(B)(8)(g) and (h). If the screen is telescoped inside the casing, a packer seal made for this purpose, or an approvable substitute, shall be lapped at least twelve (12) inches into the casing. If this screen is attached to the casing prior to lowering, centralizers shall be used and a suitable coupling shall be provided or the screen shall be welded to the casing.

(g) Method of joining screen to screen - Screen sections for a single interval shall be joined by threaded and coupled joints, socket-type fittings and solvent welding, or electric arc or acetylene welding. Welding rods and methods recommended by the screen manufacturer shall be employed. Resulting joint(s) must be straight, sand tight, and retain one hundred (100) percent of the screen strength.

Blank spacers for multiple interval screens shall be of compatible material with the screens or casing. They shall be joined to the screen by threaded and coupled joint, socket-type fittings, solvent welding, or electric arc or acetylene welding using materials and procedures specified in R.61-58.2(B)(6)(c). The resulting joints shall be straight, sand tight, and retain one hundred (100) percent of the screen strength.

(h) Method of connecting screen to casing - The connection between the screen and casing shall be by a neoprene or rubber seal especially made for this purpose, or by threaded and coupled joints, socket fittings and solvent welding, or electric arc or acetylene welding using materials and procedures listed in R.61-58.2(B)(6)(c). The resulting joints must be straight, water tight, and retain one hundred (100) percent of the screen strength.

(i) Methods of sealing bottom - The bottom of the screen shall be sealed with bagged cement or a threaded or welded plug made of compatible material with the screen body.

(9) Well Filter Construction (Artificial) - This part is applicable only to Type III wells.

(a) Filter material - Clean, well-rounded quartz particles free of limestone, clay, organic matter or other unsuitable materials shall be used.

(b) Selection of artificial filter grain size and screen aperture size - When an artificial filter is necessary, the filter grain size shall be determined from sieve analysis of the formation to be screened. The screen aperture shall be of such size as to retain between eighty-five (85) and one hundred (100) percent of the filter material. The drill hole diameter shall be carefully controlled so that the thickness of the filter medium ranges from a minimum of three (3) inches to a maximum of eight (8) inches.

(c) Length of artificial filter - The filter material shall, at a minimum, extend below the lowest screen for a distance two and a half (2.5) times the largest diameter of the well casing to the same distance above the highest screen. Where zones of inferior water quality are to be avoided, the annular space opposite the inferior zones shall be grouted in accordance with R.61-58.2(B)(7)(a) and (b).

(d) Delivery and storage of filter material - The filter material shall be protected from the weather and any contamination by bagging, or covering with plastic or canvas until used. If no protective cover is placed on the ground under the filter material, the layer in contact with the ground shall not be used.

(e) Method of installation of filter material - The filter material shall be placed with a disinfected fluid. For wells less than fifty (50) feet in depth with a short screen (5 to 10 feet), the filter material may be gravity fed from the surface if the annular space is at least six inches. For wells deeper than fifty (50) feet, a tremie pipe shall be required.

(10) Well Plumbness and Alignment - The completed well shall be sufficiently plumb and straight so that there will be no interference with installation, alignment, operation, or removal of the test or permanent pumps.

(11) Well Development - Proper well development is demonstrated by the turbidity of the water produced by the well and its sand content.

(a) Turbidity - The water produced by a completed well must have a turbidity of less than five (5.0) nephelometric turbidity units (NTU) unless it can be demonstrated that the turbidity is due to the natural water quality of the aquifer.

(b) Sand content - The maximum sand content shall be five (5) milligrams per liter or twenty (20) milligrams per gallon in the completed well.

(12) Well Testing for Performance - The Department shall be notified at least three (3) days prior to the time of the pumping test. The pumping test shall not be conducted until the well has been adequately developed.

(a) Type of pumping test performed - Pump tests to fully evaluate the yield and specific capacity shall be performed on all newly constructed wells and shall be performed for a minimum of twenty-four (24) hours at the design or maximum capacity of the well. The test procedure shall be based on good hydro-geologic practice.

(b) Aborted tests - Whenever there is an interruption in pump operation for a period greater than one percent of the elapsed pumping time, there shall be a suspension of the test until the water level in the pumped well has recovered to the static level. The test must be restarted and run for the full twenty-four (24) hour period.

(c) Location of discharge - Water shall be discharged so that it will not affect test results and so that no damage by flooding or erosion is caused to the chosen drainage structure or disposal site. The location of the discharge point shall be shown on the site plan and precautions must be taken to ensure the protection of flora and fauna.

(d) Record of tests - Accurate records shall be kept of the test along with weather conditions and other pertinent information. Two (2) copies shall be furnished to the Department prior to construction of the pumping, treatment or distribution facilities associated with the well or with the engineer's certification letter if the project is permitted in one step. The records shall also be available for inspection at any time during the test. At a minimum the record shall include the following information:

(i) time the test was started;

(ii) method of measuring the pumping rate and water level;

(iii) pumping rate and water level measurements every 15 minutes for the first three (3) hours and at least hourly for the remainder of the test;

(iv) water level measurements every fifteen (15) minutes for the first three (3) hours following the end of pumping and hourly thereafter; and,

(v) name of the person(s) conducting the test.

(e) Measurement of water levels - The method of taking water level measurements shall have an accuracy to within plus or minus one tenth (0.1) of a foot. The air line method, steel tape method, or electric sounder method may be used according to proper procedures.

(13) Well Disinfection -

(a) Scheduling disinfection - The well shall be disinfected at the following times during construction:

(i)The well shall be disinfected as soon as construction of the well and cleaning procedures have been completed. All oil, grease, soil, and other materials which could harbor and protect bacteria from disinfectants shall be removed from the well. Unless prior approval is obtained for employing chemicals or unusual cleaning methods, the cleaning operation shall be carried out by pumping and swabbing only.

(ii) The well shall be disinfected after completion of the performance testing and sampling. The well shall be capped in accordance with R.61-58.2(B)(6)(d) and shall be protected from vandalism until the permanent pump is installed.

(iii) The well shall be disinfected after installation of the thoroughly scrubbed and cleaned permanent pump.

(b) Disinfectants - Chlorine disinfectant shall be delivered to the site of the work in original closed containers bearing the original label indicating the percentage of available chlorine. The disinfectant shall be recently purchased (chlorine compounds in dry form shall not be stored for more than one year and storage of liquid compounds shall not exceed 60 days). During storage, disinfectants shall not be exposed to the atmosphere or to direct sunlight. The quantity of chlorine compounds used for disinfection shall be sufficient to produce a minimum of fifty (50) milligrams per liter available chlorine in solution when mixed with the total volume of water in the well.

(c) Disinfection procedure - For each disinfection, a reliable means shall be provided for ensuring that the disinfecting agent is uniformly applied throughout the entire depth of the well including the casing, pipes and wiring above the water level. The disinfection shall be in accordance with current AWWA Standards for disinfection of wells.

After the contact period, the well shall be pumped to clear it of the disinfecting agent. The disposal point for the purged water shall be selected so as to avoid damage to aquatic life or vegetation.

(14) Water Samples and Analyses - All samples shall be appropriately identified by the well identification number assigned by the Department, date, and time and shall include the name of the sample collector, contractor and owner. The samples shall be analyzed by a certified laboratory. Test results shall be provided to the Department prior to the construction of the pumping and treatment facilities (if applicable) or with the engineer's certification letter if the project is permitted in one step.

(a) Bacteriological analysis - Prior to sampling, the well shall be pumped until the chlorine residual in non-detectable. Two consecutive samples of water shall be collected at least twenty-four (24) hours apart and be analyzed for total coliform bacteria. The results of both samples must show the absence of total coliform bacteria using membrane filter methodology. The measured chlorine residual and non-coliform growth must also be reported. If the non-coliform growth is greater than eighty (80) colonies per one hundred (100) milliliters, the sample result will be deemed invalid and must be repeated. All samples must be analyzed by a laboratory certified by the Department. The Department may request that heterotrophic plate count analyses be conducted on a case- by-case basis where construction, development, or disinfection problems are suspected.

(b) Chemical and radiological analysis - Representative clear samples shall be properly collected and preserved and shall be analyzed by a certified laboratory. The sample shall be analyzed for all contaminants listed in R.61-58.5 and all other parameters needed to determine the aggressiveness of the water to include, pH, total alkalinity, calcium, hardness, total dissolved solids, temperature, and shall be delivered to the laboratory no more than thirty (30) hours after its collection. The pH and temperature measurements shall be made in the field using certified methodology.

(c) Special monitoring for direct surface water influence - For those wells meeting the requirements of R.61-58.2(B)(3)(c), and for any other well deemed necessary by the Department because of location, depth, testing analysis, or other pertinent information, the following special monitoring must be conducted:

(i) quarterly analyses, for a period of one (1) year, of the untreated well water for total and fecal coliform bacteria;

(ii) analyses for pH, turbidity, temperature, and conductivity before and after two or more heavy rainfall events (at least 2 inch over a 24 hour period); and,

(iii) where the above analysis indicates a possible problem, microscopic particulate analysis must be conducted.

If these analyses indicate that the well is under direct surface water influence, treatment must be added and monitoring conducted in accordance with R.61-58.10 or the well must be abandoned in accordance with R.61-58.2(B)(15).

(15) Permanent Well and Test Hole Abandonment - All wells and test holes that are not completed as a production, monitoring or observation well shall be properly abandoned. Abandonment of these wells shall be performed by a certified well driller.

(a) Aquifer sealing materials - The well to be abandoned shall be filled with neat cement, sand-cement, bentonite-cement or concrete. The neat cement, sand-cement or bentonite-cement mixtures shall be as specified in R.61-58.2B(7)(a).

(b) Placement of sealing material - Sealing materials used in abandonment operations shall be placed in such a way as to avoid segregation or dilution of the sealing materials. Dumping sealing material from the top shall not be permitted. Special consideration shall be given to the following:

(i) the abandonment of flowing artesian wells;

(ii) a borehole or well which is to be abandoned due to contamination shall be considered a special case, and the method of filling and sealing such wells shall be subject to individual review and prior written approval by the Department.

(iii) In the sealing of a double or multiple cased well, the certified well driller shall submit, for prior approval, a drawing thereof with a description of the proposed procedure and materials to be used to completely and permanently seal both the well and any column of filter pack that extends to the ground surface.

(iv) Bridging for deep wells - Very deep wells that do not require complete filling for sanitary protection may be backfilled with clean sand or gravel to the depth appropriate for the bottom of the plug of sealing materials. Where open casing (types II or III wells) or open borehole (types I or IV wells) is to remain below the sealed depth, a temporary bridge or plug made of inorganic materials (e.g., metal, cement) or manufactured devices specifically designed for this purpose in well construction and made of plastic or other elastic materials (e.g., neoprene, rubber) may be used to support the column of sealing materials until they cure and bond to the casing or borehole. The column of sealing materials is installed above the temporary bridge.

In Type I or IV wells, the column of permanent sealing materials may be set with the bottom at least ten (10) feet below the top of firm bedrock or limestone and extending up to within five (5) feet of the ground surface. The casing may be removed if desired and the borehole abandoned by grouting instead. The upper most five (5) feet may be filled with soil suitable for the intended land use.

In Type II or III wells, the sealing materials shall extend down to at least fifty (50) feet below ground surface, except that the uppermost five (5) feet of the borehole may be filled with soil suitable for the intended land use. Casing may be removed, if desired, and the borehole abandoned by grouting.

(v) In abandoning all new wells (test wells, wells of insufficient yield, unacceptable water quality, etc.) the casing must be properly installed with the appropriate grouted material or else removed and the borehole abandoned by grouting.

(vi) Contaminated wells - wells tapping multiple aquifers of different hydrostatic heads or wells tapping multiple zones of significantly different water quality must be abandoned in a manner such that contaminated or lower quality water does not migrate through the abandoned well or borehole and such that ongoing large vertical transfers of water between aquifers, of any quality, do not occur. The methods proposed for sealing such wells shall be reviewed and will require prior written approval by the Department, completely filling an uncased borehole with sealing materials shall be acceptable without prior approval.

(vii) In sealing a double wall or multiple cased well, the certified well driller shall submit a drawing with a description of the proposed procedure.

(c) Well abandonment records - Before the equipment is removed from the site, the exact location of the abandoned well or hole shall be accurately surveyed and a record made to the location with respect to several fixed reference points. All information relative to the abandonment procedures, the location, depth, and diameter of the well or hole shall be supplied in writing to the owner and the Department.

(16) Well Head Piping and Pumping Facilities.

(a) General Requirements:

(i) A sanitary seal must be provided on the top of the well casing. A pressure gauge and air line or other method for readily measuring the water level in the well shall also be provided.

(ii) A casing vent elbowed downward must be provided for the well casing a minimum of eighteen (18) inches above the well house floor (except on packer jet wells). The vent can be gooseneck type with twenty-four (24) mesh screen over the opening or manufactured slotted pipe with effective opening of .024 inches or smaller.

(iii) A check valve shall be provided on the pump discharge above the top of the casing. For jet pumps, no check valve is required in the main line but a back- flow/back-siphonage device must be provided on blow offs and sample cocks.

(iv) A sampling tap must be provided for raw water sampling downstream of the check valve and prior to any chemical injection point. If chemical feed is provided at the well head, a second sample tap shall be provided downstream of the last injection point. This second sampling tap shall be located following adequate mixing of the chemical(s), but prior to any storage tank. A static in-line mixer may be required to ensure that adequate mixing of the chemical(s) has taken place prior to the sampling tap.

(v) Adequate control switches, etc., for the pumping equipment must be provided. A pressure relief valve must be provided and shall not be separated by a valve from the controlling device.

(vi) A flow meter shall be provided on:

(A) each well serving a community water system;

(B) each well serving a non-transient non-community water system;

(C) each well which is equipped with treatment; and,

(D) any other public water supply well where the yield of the well, while pumping against the normal working pressure of the system, cannot be easily measured from the blow-off using a bucket and stopwatch or by some other readily accessible means of measuring flow.

The flow meter shall be capable of measuring instantaneous and totalized flow.

(vii) Adequate support for the well pump and drop pipe must be provided.

(viii) An hour meter shall be provided to record the elapsed run time of each well pump which is required to have a flow meter.

(ix) A valved blow-off shall be provided and located prior to any chemical feed but downstream of the flow meter.

(x) A manual control switch shall be provided for each well pump.

(xi) All electrical wiring shall be in conduit and meet the requirements of the National Electric Code.

(xii) Each well pump station must have a sign on the door with a twenty-four (24) hour telephone number for emergencies.

(xiii) Wells or well pump stations in pits are prohibited.

(xiv) All wells shall be readily accessible at all times for inspection, maintenance and sampling. Also, well houses shall be constructed in a manner and of material that will allow one person easy access to the sampling tap(s) and the well head piping for inspection, maintenance and sampling.

(b) Turbine pumps - Drilled wells with the prime mover mounted on the casing (Turbine pumps) shall:

(i)Have the casing equipped with a flange or suitable sanitary seal;

(ii) Have the casing firmly connected to the pump structure or have the casing inserted into a recess extending at least one inch into the base of the pump if a watertight connection is not provided;

(iii) Have the base of the pump not less than twelve (12) inches above the pump room floor or apron;

(iv) Have the pump foundation and base designed to prevent water from coming into contact with the joint between the casing and the prime mover; and,

(v) Have an air release valve installed on the discharge pipe upstream of the check valve.

(c) Submersible Pumps - Where a submersible pump is used, the top of the casing shall be effectively sealed against entrance of water under all conditions of vibration or movement of conductors or cables. For hydropneumatic systems not equipped with an air compressor, the discharge pipe shall be equipped with a snifter (a device which will allow air to enter the drop-pipe) upstream of the check valve and a bleeder valve on the drop-pipe located above the static water level in the well.

(d) Well head piping - The well head piping shall be provided with a valved means to pump waste to a point away from the groundwater source, but shall not be directly connected to a sewer. Neither the well head nor the well head piping shall be buried below grade or in a pit. The discharge line shall:

(i) Have control valves located above the pump floor;

(ii) Be protected against freezing;

(iii) Be valved to permit testing and control of each well;

(iv) Have watertight joints;

(v) Have all exposed valves protected; and,

(vi) Have erosion protection at the point of discharge from the blow-off.

(e) Water Seals - Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality the seal shall be provided with a back- flow preventer appropriate for the degree of hazard in question.

(f) Water Pre-lubrication - When automatic pre-lubrication of pump bearings is necessary and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved bypass around the automatic control so that the bearings can, if necessary, be lubricated manually before the pump is started.

C. General Design Requirements.

(1) Plant Layout - Design shall provide for an adequate access road, site drainage, protection of well(s) from spillage, and adequate protection from vandalism. Consideration shall also be given to functional aspects of the plant layout and future expansion.

(2) Building Layout - Design shall provide, if necessary, for adequate ventilation, lighting, telephone service, heating and air conditioning, floor drainage, and dehumidification equipment. Consideration shall also be given to accessibility of equipment for operation, servicing, and removal, telephone communication capability, flexibility of operation, operator safety, and convenience of operation.

(3) Electrical Controls - Main switch gear electrical controls shall be located above grade and protected from standing water.

(4) Auxiliary Power - Where elevated storage equals less than one half maximum daily demand, portable or in-place auxiliary power shall be provided for all systems serving three hundred (300) or more service connections. An air quality permit may be required for the emissions from the auxiliary generators. Auxiliary power requirements may be waived if one or more of the following are applicable:

(a) a verifiable history of worst case power outages and verification that the available elevated storage can provide for a similar time period of outage;

(b) two (2) or more independent sources from the serving electrical utility are available; or,

(c) an alternate water source is available via connections with other systems.

Auxiliary power shall be sized to provide for sufficient pumping and treatment capacity to meet one half (½) of the maximum daily demand or to supplement the existing storage to meet one half (½) of the maximum daily demand.

(5) Sample Taps - Sample taps shall be provided so that water samples can be obtained from:

(a) each raw water source;

(b) appropriate locations throughout the treatment process so that the operator can maintain proper control of the treatment process;

(c) effluent from each filter prior to any post chemical addition; and,

(d) the entry point(s) to the distribution system.

Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads. Taps shall not be of the mixing type, and shall not have a screen, aerator, or other such appurtenances. All sampling taps shall be easily accessible and located at least 12 inches above the floor or ground level.

(6) Chemical injection points - All chemical injection points shall be downstream of the check valve on the wellhead piping.

(7) All chemical treatment equipment shall be enclosed and protected from the weather.

(8) Process Water - The process water service line shall be supplied from a source at a point where all chemicals have been thoroughly mixed.

(9) Piping Identification - To facilitate identification of piping where treatment occurs, all pipes shall be color coded and/or marked with the name of the liquid or gas being carried and its direction of flow.

(10) Proprietary Treatment Units/Innovative Treatment Techniques - Proprietary treatment units and alternative treatment technology may be considered if pilot tests demonstrate the ability of the technology to provide water which meets all drinking water standards utilizing the proposed groundwater source. The unit/technology will be approved only at rates consistent with R.61-58.2(D) until satisfactory operating data for at least eighteen (18) months is obtained.

(11) Manuals and Parts Lists - An operation and maintenance manual shall be provided for each installation. This manual shall include repair information, parts lists for each piece of equipment, and procedures for the start up and shut down of the facility.

(12) Safety - All design must meet applicable safety codes and minimum Occupational Safety and Health Administration (OSHA) standards.

D. Groundwater Treatment.

(1) Filtration - All filters treating groundwater under the direct influence of surface water must meet the performance standards set forth in R.61-58.10(E).

The application of any one type of filtration must be supported by water quality data.

Experimental treatment studies may be required to demonstrate the applicability of the method of filtration proposed.

(a) Pressure Filters - The use of these filters may be considered for iron and manganese removal and other clarification processes.

(i) Rate of Filtration - The nominal rate shall be three (3) gallons per minute per square foot of filter area and shall not exceed five (5) gallons per minute per square foot without adequate justification.

(ii) Details of Design - The filter design shall address the following:

(A) Pressure gauges on the inlet and outlet pipes of each filter shall be provided.

(B) Provisions shall be made for filtration and backwashing of each filter individually with an arrangement of piping as simple as possible to accomplish these purposes.

(C) The backwash water collection system shall be designed to allow for adequate bed expansion without loss of media.

(D) The underdrain system shall efficiently collect the filtered water and shall distribute the backwash water uniformly at a rate not less than fifteen (15) gallons per minute per square foot of filter area.

(E) Backwash flow indicators and controls shall be located such that they are easily readable while operating the control valves.

(F) An air release valve on the highest point of each filter shall be provided.

(G) An accessible manhole to facilitate inspections and repairs (above level of media) shall be provided.

(H) A means to observe the wastewater during backwashing shall be provided.

(I) No unprotected cross connections shall exist.

(J) Filter material must be in accordance with R.61- 58.3(D)(5)(a)(vi).

(K) A sufficient number of filter units so as to ensure continuity of service with one unit temporarily removed from operation. The facility shall be designed so that the design filtration rate is not exceeded during backwash operation.

(L) Filter material shall have a total depth of not less than twenty- four (24) inches and generally not more than thirty (30) inches.

(M) Only finished water from the treatment process shall be used to backwash the filter(s).

(b) Gravity Filters - Gravity filters shall be designed in accordance with applicable portions of R.61-58.3(D)(5).

(c) Diatomaceous earth filtration

(i) Conditions of use - Diatomaceous earth filters are expressly excluded from consideration for bacteria removal, color removal, or turbidity removal where either the gross quantity of turbidity is high or the turbidity exhibits poor filterability characteristics.

(ii) Pilot plant study - Installation of a diatomaceous earth filtration system shall be preceded by a pilot plant study on the water to be treated.

(A) Conditions of the study such as duration, filter rates, head loss accumulation, slurry feed rates, turbidity removal, bacteria removal, etc., shall be approved by the Department prior to the study.

(B) Satisfactory pilot plant results shall be obtained prior to preparation of final construction plans and specifications.

(C) The pilot plant study shall demonstrate the ability of the system to meet applicable drinking water standards at all times.

(iii) Types of filters - Pressure or vacuum diatomaceous earth filtration units will be considered for approval.

(iv) Treated water storage - Treated water storage capacity in excess of normal requirements shall be provided to allow operation of the filters at a uniform rate during all conditions of system demand at or below the approved filtration rate, and guarantee continuity of service during adverse raw water conditions without by-passing the system.

(v) Precoat Application - A uniform precoat of at least 1/16 inch shall be applied hydraulically to each septum by introducing a slurry to the tank influent line and employing either a filter-to-waste or recirculation system.

(vi) Body feed - A body feed system to apply additional amounts of diatomaceous earth slurry during the filter run is required. Continuous mixing of the body feed slurry shall be provided.

(vii) Filtration

(A) Rate of filtration - The filtration rate shall be controlled by a positive means and shall not exceed one and a half (1.5) gallons per minute per square foot of filter.

(B) Head loss - The head loss shall not exceed thirty (30) pounds per square inch for pressure diatomaceous earth filters, or a vacuum of fifteen (15) inches of mercury for a vacuum system.

(C) Recirculation - A recirculation or holding pump shall be employed to maintain differential pressure across the filter when the unit is not in operation in order to prevent the filter cake from dropping off the filter elements. A minimum recirculation rate of one tenth (0.1) gallon per minute per square foot of filter area shall be provided.

(D) Septum or filter element - The filter elements shall be structurally capable of withstanding maximum pressure and velocity variations during filtration and backwash cycles, and shall be spaced such that no less than one (1) inch is provided between elements or between any element and a wall.

(E) Inlet design - The filter influent shall be designed to prevent scour of the diatomaceous earth from the filter element.

(viii) Backwash - A satisfactory method to thoroughly remove and dispose of spent filter cake shall be provided.

(ix) Appurtenances - The following shall be provided for every filter:

(A) sampling taps for raw and filtered water;

(B) loss of head or differential pressure gauge;

(C) rate-of-flow indicator, with totalizer;

(D) a throttling valve used to reduce rates below normal during adverse raw water conditions; and,

(E) an evaluation of the need for body feed, recirculation, and any other pumps, in accordance with R.61-58.4(B)(1)(d).

(2) Disinfection - Disinfection may be accomplished with liquid chlorine, calcium or sodium hypochlorite, chlorine dioxide, ozone or chloramines. Other agents will be considered by the Department provided that reliable feed equipment is available and test procedures for a residual are recognized, and the agent meets the requirements of an acceptable drinking water additive. Continuous disinfection will be required at groundwater supplies which are of questionable sanitary quality or where any other treatment is provided. Due consideration shall be given to the contact time of the disinfectant in water with relation to pH, ammonia, taste-producing substances, temperature, bacterial quality, and other pertinent factors. Consideration also must be given to the formation of disinfection by-products.

(a) Chlorination - Where chlorine is used the following shall apply:

(i) Type - Only vacuum type gas chlorinators or hypochlorite feeders of the positive displacement type are acceptable.

(ii) Capacity - The chlorinator capacity shall be such that a free chlorine residual of at least five (5) milligram per liter can be attained in the water after a contact time of at least thirty (30) minutes at maximum flow rates. The equipment shall be of such design that it will operate accurately over the desired feeding range.

(iii) Automatic Proportioning - Automatic proportioning chlorinators will be required where the rate of flow or chlorine demand is not reasonably constant or where the rate of flow of the water is not manually controlled.

(iv) Residual chlorine - Where alternate disinfectants are used in the treatment process, the capability for the addition of either free or combined chlorine in the finished water shall be provided.

(b) Cross connection protection - The chlorinator water supply piping shall be designed to prevent contamination of the treated water supply by sources of questionable quality.

(c) Chlorine gas - Consideration shall be given to the location of gas chlorine facilities and the safety of the public in the surrounding area. The Department reserves the right to deny approval of chlorine gas on the basis of hazards to the public health. Consideration may be given for facilities that propose the use of chlorine gas in inhabited areas when the use of safety devices which will not allow the release of chlorine gas (e.g. chlorine scrubbers) are provided. Only vacuum gas chlorinator systems will be approved.

(i) Chlorine gas feed equipment shall be enclosed and separated from other operating areas. Concrete, wood, and other construction materials shall be sealed to prevent the escape of chlorine gas from the chlorine building. The chlorine room shall be provided with a shatter resistant inspection window installed in an interior wall or an inspection window in the door. It shall be constructed in such a manner that all openings between the chlorine room and the remainder of the plant are sealed, and shall be provided with doors ensuring ready means of exit and opening only to the building exterior.

(ii) Full and empty cylinders of chlorine gas shall be isolated from operating areas, restrained in position to prevent upset, stored in rooms separate from ammonia storage, and stored in areas not in direct sunlight or exposed to excessive heat.

(iii) If the chlorine room is large enough for a person to enter, the room shall be constructed such that:

(A) It has a ventilating fan with a capacity which provides one complete air change per minute;

(B) The ventilating fan shall be located near the ceiling and pull suction through a duct extending to within twelve (12) inches of the floor and discharge as far as practical from the door and air inlet. The point of discharge shall be located so as not to contaminate air inlets to any rooms or structures. A sealed motor or other means shall be used to ensure the reliability of the fan;

(C) Air inlets shall be located near the ceiling;

(D) Air inlets and outlets shall have mechanical louvers;

(E) Switches for fans and lights are outside of the room, at the entrance;

(F) Vents from feeders and storage areas discharge to the outside atmosphere, above grade and away from inlet vent; and,

(G) Ventilation shall not be automatically controlled.

(iv) If the room is too small for a person to enter, the room must meet the requirements of R.61-58.2(D)(2)(c)(iii)(E) and (F).

(v) Chlorine feed lines shall meet the following requirements:

(A) Chlorine gas under pressure shall be piped with schedule eighty (80) stainless steel or schedule eighty (80) seamless carbon steel. No chlorine gas under pressure will be piped beyond the chlorinator room.

(B) Chlorine gas under vacuum shall be piped with schedule eighty (80) PVC or reinforced fiberglass.

(C) Chlorine solution shall be piped with schedule eighty (80) PVC.

(vi) Heaters shall be provided to maintain proper temperature for operation.

(vii) There shall be no equipment housed in the chlorine room except chlorinators, chlorine cylinders, weighing scales, heater, ventilation fan, and light(s).

(viii) Weighing scales shall be provided for weighing cylinders, at all installations utilizing chlorine gas unless provisions for automatic switchover of cylinders and an acceptable alternate means to determine daily dosage are provided.

(ix) Chlorine feed systems shall be designed to ensure continuous feed of chlorine.

(x) If a floor drain is provided, it shall be equipped with a water seal or trap to prevent escaped gases from exiting through the building sewer.

(xi) A chlorine leak detection and alarm system shall be provided.

(xii) An air pack approved by the National Institute for Occupational Safety and Health shall be available for each gas chlorination installation.

(xiii) A chlorine cylinder repair kit for plugging the type of chlorine cylinders used shall be available for each gas chlorination installation.

(d) Ozone - Ozone is a suitable disinfectant for groundwater. On-site generation facilities shall be constructed in accordance with manufacturer's standards.

(i) Pilot plant tests - Pilot plant tests shall be performed with the water to be treated to establish the optimum dosage, contact time, depth of conductor and the need for multiple application points.

(ii) Building Design - Ozone generators shall be housed in a separate room with separate heating and ventilation. The building layout must provide for easy access to the equipment. Ventilation equipment shall be two (2) speed with the normal speed providing the normal distribution of heat or air movement. The second speed must be capable of providing a complete turnover of the air in the room every two (2) minutes to exhaust any ozone leakage in an emergency.

(iii) Piping Materials

(A) All dry ozone gas piping shall be mechanical jointed number 304 or 316 stainless steel or welded 304L or 316L stainless steel. All wet ozone gas piping shall be number 316 or 316L stainless steel. All flexible couplings shall be stainless steel.

(B) Valves shall be stainless steel face and body.

(C) Gasket materials shall be resistant to deterioration by the ozone.

(iv) Reinforced concrete or stainless steel are acceptable materials. All concrete joints shall be sealed using a synthetic rubber material resistant to deterioration by the ozone.

(e) Other disinfection agents - Any proposal for the use of other disinfecting agents shall be approved by the Department prior to preparation of final plans and specifications.

(f) Ammonia Gas - Consideration shall be given to the location of ammonia gas facilities and the safety of the public in the surrounding area. The Department reserves the right to deny approval of ammonia gas on the basis of hazards to the public health. Only vacuum ammonia systems will be approved.

(i) Ammonia gas feed equipment shall be enclosed and separated from other operating areas. Concrete, wood, and other construction materials shall be sealed to prevent the escape of ammonia gas from the ammonia room. The ammonia room shall be provided with a shatter resistant inspection window installed in an interior wall or an inspection window in the door. It shall be constructed in such a manner that all openings between the ammonia room and the remainder of the plant are sealed, and shall be provided with doors ensuring ready means of exit and opening only to the building exterior.

(ii) Full and empty cylinders of ammonia gas shall be isolated from operating areas, restrained in position to prevent upset, stored in rooms separate from chlorine storage, and stored in areas not in direct sunlight or exposed to excessive heat.

(iii) If the ammonia room is large enough for a person to enter, the room shall be constructed such that:

(A) It has a ventilating fan with a capacity which provides one complete air change per minute;

(B) The ventilating fan shall be located and pull suction near the ceiling and discharge as far as practical from the door and air inlet. The point of discharge shall be located so as not to contaminate air inlets to any rooms or structures. A sealed motor or other means shall be used to ensure the reliability of the fan;

(C) Air inlets shall be located near the floor;

(D) Air inlets and outlets shall have mechanical louvers;

(E) Switches for fans and lights are outside of the room, at the entrance;

(F) Vents from feeders and storage areas discharge to the outside atmosphere, above grade and away from inlet vent; and,

(G) Ventilation shall not be automatically controlled.

(iv) If the room is too small for a person to enter, the room must meet the requirements of R.61-58.2(D)(2)(f)(iii)(E) and (F).

(v) Ammonia feed lines shall not carry ammonia gas beyond the ammonia room.

(vi) There shall be no equipment housed in the ammonia room except ammoniators, ammonia cylinders, weighing scales, heater, ventilation fan, and light(s).

(vii) Weighing scales shall be provided for weighing cylinders, at all installations utilizing ammonia gas from cylinders. Where bulk storage tanks are installed, they shall be equipped with a pressure gauge.

(viii) An ammonia leak detection and alarm system shall be provided.

(g) Chlorine Dioxide - Chlorine dioxide is a suitable disinfectant for groundwater. Chlorine dioxide shall be generated on site. The unit shall be flow paced and not have a holding tank for the chlorine dioxide solution generated. All applicable EPA disinfectant by-product rules shall be observed.

(i) Sizing of the chlorine dioxide generator - Chlorine dioxide demand studies shall be conducted to determine estimated feed rates and points of feed.

(ii) Building Design -

(A) Chlorine dioxide generators shall be located in a room separate from chlorine cylinders.

(B) Number of Units: Where chlorine dioxide is used as the primary disinfectant, at least two (2) flow pacing chlorine dioxide generators shall be provided. The facility shall be adequately sized to supply the maximum treatment capacity with any one generator out of service. If chlorine dioxide is not used as a primary disinfectant (i.e. an oxidant only), a second generator is not required.

(iii) Piping Materials -

(A) All piping from the chlorine dioxide generator shall be schedule 80 PVC

(B) Gasket materials shall be kynar or other compatible material.

(C) All tubing connector fittings shall be kynar or other compatible material.

(3) Softening - The softening process selected shall be based upon the mineral qualities of the raw water and the desired finished water quality in conjunction with requirements for the disposal of brine waste, the plant location. Applicability of the process chosen shall be demonstrated. Ion exchange units used for softening shall be designed in accordance with R.61-58.2.D(4).

(4) Ion Exchange Process - The total iron and manganese concentration shall not exceed three tenth (0.30) milligrams per liter in the water as applied to the ion exchange material. Pretreatment is required when the total iron and manganese concentration exceeds is three tenth (0.3) milligram per liter or more.

(a) Design - The units may be of pressure or gravity type, of either an upflow or downflow design. A manual override shall be provided on all automatic controls.

(b) Exchange Capacity - The design capacity for hardness removal shall not exceed twenty thousand (20,000) grains per cubic foot when resin is regenerated with three tenth (0.3) pounds of salt per kilograin of hardness removed.

(c) Depth of Media - Exchange resin shall have a total depth of not less than twenty- four (24) inches and generally not more than thirty (30) inches unless otherwise approved by the Department.

(d) Flow Rates - The rate of softening shall be based on an actual bench scale test of the water to be treated. The backwash rate shall be sufficient to clean the bed. The flow rate will be dependent on the grain size and specific gravity of the exchange resin.

(e) Bypass - A bypass may be provided around softening units to produce a blended water of desirable hardness. Meters shall be installed on the bypass line and on each softener unit.

(f) Additional limitations - Waters having five (5) units or more turbidity shall not be applied directly to the cation exchange softener. Silica gel resins shall not be used for waters having a pH above 8.4 and shall not be used when iron is present. When the applied water contains a chlorine residual, the cation exchange resin shall be a type that is not damaged by residual chlorine. Phenolic resin shall not be used.

(g) Sampling Taps - Smooth-nose sampling taps shall be provided for the collection of representative samples for both bacteriological and chemical analyses. The taps shall be located to allow sampling of the

softener influent, the softener effluent, and the blended water. The sampling taps for the blended water shall be at least twenty (20) feet downstream from the point of blending. Petcocks are not acceptable as sampling taps.

(h) Brine and Salt Storage Tanks - Brine measuring or salt dissolving tanks and wet salt storage facilities shall be covered and shall be constructed of corrosion-resistant material. The make-up water inlet shall have a free fall discharge of two (2) pipe diameters above the maximum liquid level of the unit, or shall be protected from back- siphonage by use of a vacuum breaker. The salt shall be supported on graduated layers of gravel under which is a suitable means of collecting the brine. Wet salt storage basins shall be equipped with manhole or hatchway openings having raised curbs and watertight covers having overhanging edges. Overflows, where provided, must be angled downward, have a proper free fall discharge and be protected with noncorrodible screens or self-closing flap valves.

(i) Storage Capacity - Wet salt storage basins shall have sufficient capacity to provide for at least three (3) days of operation.

(j)Corrosion Control - Corrosion control shall be provided.

(k) Waste Disposal - A suitable means of handling and disposal shall be provided for brine waste designed in accordance with 61-58.2(F).

(*l*) Construction Material - Pipes and contact materials shall be corrosion resistant.

(m) Housing - Salt storage tanks and feed equipment shall be enclosed.

(5) Aeration - Aeration treatment devices, as described herein, may be used for oxidation, separation of gases or for taste and odor control. A separate air quality permit for the separation of gases from water by aeration may be necessary.

(a) General Requirements

(i) Sample taps must be provided following aeration equipment.

(ii) Where aeration equipment discharges directly to the distribution system, air release valves must be provided.

(b) Natural Draft Aeration - Design shall provide that:

(i) Water is distributed uniformly over the top tray;

(ii) Water is discharged through a series of three (3) or more trays with the separation of trays not less than twelve (12) inches;

(iii) Trays are loaded at a rate of one (1) gallon per minute to five (5) gallons per minutes for each square foot of total tray area;

(iv) Trays have slotted, woven wire cloth or perforated bottoms;

(v) Perforation are three sixteenth (3/16) to one-half (½) inches in diameter, spaced one (1) to three (3) inches on centers, when perforations are used in the distribution pan;

(vi) Construction of durable material resistant to the aggressiveness of the water and dissolved gases;

(vii) Protection of aerators from loss of spray water by wind carriage by enclosure with louvers sloped to the inside at an angle of approximately forty-five (45) degrees;

(viii) Protection from insects by number twenty-four (24) mesh screen; and,

(ix) Aerated water receives disinfection treatment.

(c) Forced or Induced Draft Aeration - Devices shall be designed to:

(i) Provide an adequate countercurrent of air through the enclosed aeration column;

(ii) Include a blower in a screened enclosure and with a watertight motor;

(iii) Exhaust air directly to the outside atmosphere;

(iv) Include a down-turned, number twenty-four (24) mesh screened air outlet and inlet;

(v) Be such that air introduced in the column shall be as free from noxious fumes, dust, and dirt as possible;

(vi) Be such that sections of the aerator can be easily reached or removed for maintenance of the interior;

(vii) Provide loading at a rate of one (1) to five (5) gallons per minute for each square foot of total tray area;

(viii) Ensure that the water outlet is adequately sealed to prevent the unwarranted loss of air;

(ix) Discharge through a series of five (5) or more trays, with separation of trays not less than six (6) inches;

(x) Provide distribution of water uniformly over the top tray; and,

(xi) Be of a durable corrosion resistant material.

(d) Pressure Aeration - This method may be used for oxidation purposes if pilot plant study indicates method is applicable. It is not acceptable for removal of dissolved gases. Filters following pressure aeration shall have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to give thorough mixing of compressed air with water being treated. Screened and filtered air, free of noxious fumes, dust, dirt and other contaminants shall be provided.

(e) Other Methods of Aeration - Other methods of aeration may be used if applicable to the treatment needs. Such methods may include, but are not restricted to, spraying, diffused air, cascades, and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated and shall be subject to Department approval.

(f) Protection from Contamination - Aerators that are used for oxidation or removal of dissolved gases from waters that will be given no further treatment other than chlorination shall be protected from contamination from insects and birds by a roof or similar structure.

(g) Disinfection - Groundwater supplies exposed to the atmosphere by aeration must receive chlorination as a minimum additional treatment.

(6) Iron and Manganese Control - Iron and manganese control, as used herein, refers solely to treatment processes designed specifically for this purpose.

(a) Removal by Oxidation, Detention and Filtration.

(i) Oxidation - Oxidation shall be by aeration or by chemical oxidation with chlorine, potassium permanganate, chlorine dioxide, ozone or other oxidant approved by the Department.

(ii) A minimum detention of twenty (20) minutes shall be provided following oxidation by aeration to ensure that the oxidation reactions are as complete as possible. This minimum detention shall be omitted only where a pilot plant study or an analogous system indicates no need for detention.

(iii) Sedimentation basins shall be provided when treating water with high iron and/or manganese content or where chemical coagulation is used to reduce the load on the filters.

(A) Detention time - Sedimentation basin design considerations and calculations shall include basin overflow rate, weir loading rate, flow through velocity and theoretical detention time.

(B) Inlet Devices - Inlets shall be designed to distribute water equally and at uniform velocities. The structures shall be designed so as to dissipate inlet velocities and provide uniform flows across the basin.

(C) Outlet Devices - Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short circuiting.

(D) Velocity - The velocity through settling basins shall not exceed five tenths (0.5) of a foot per minute. The basins shall be designed to minimize short circuiting. Baffles shall be provided, as necessary.

(E) Overflow - An overflow weir (or pipe) shall be installed to establish water level in the basin.

(F) Sludge handling - Facilities are required by the Department for the disposal of sludge and shall be designed in accordance with R.61- 58.2F. Provisions shall be made for the operator to observe and sample sludge being withdrawn from the unit.

(G) Washdown Hydrants - Washdown hydrants shall be provided and shall be equipped with backflow prevention devices acceptable to the Department.

(iv) Filtration - Filters shall conform to R.61-58.2(D)(1).

(b) Removal by Manganese Green Sand Filtration

(i) An anthracite media cap of at least six (6) inches shall be provided over manganese green sand.

(ii) The filtration rate will be dependent on the raw water quality and the type of filter used. It shall not exceed three (3) gallons per minute per square foot.

(iii) The backwash rate shall be sufficient to clean the bed.

(iv) Sample taps shall be provided prior to the application of permanganate; immediately ahead of filtration; at a point between the anthracite coal media and the manganese treated greensand; halfway down the manganese treated greensand; and at the effluent for each filter.

(v) A differential pressure gauge or separate inlet and outlet pressure gauges shall be provided to measure the loss of head through the unit.

(c) Removal by Ion Exchange - Iron removal with sodium zeolite ion exchange units shall not be approved without a pilot study addressing the efficiency of removal, an evaluation of the potential for bed fouling, and consideration of the corrosiveness of the treated water. The Ion Exchange process treatment shall be designed in accordance with R.61-58.2(D)(4).

(d) Sequestration by phosphates - Where phosphate treatment is used, sufficient disinfectant residuals shall be maintained in the distribution system.

(i) Phosphates shall not be applied ahead of the filters in iron and manganese removal treatment. Where there is no removal treatment, the phosphate shall be added prior to any disinfection.

(ii) Phosphate chemicals shall meet the requirements of chemical additives in R.61-58.2(E)(3), including maximum feed rates.

(e) Sampling Taps - Smooth-nosed sampling taps shall be located on each source, each treatment unit influent and each treatment unit effluent.

(7) Fluoridation - Commercial sodium fluoride, sodium silicofluoride and hydrofluorosilic acid shall be NSF approved and shall conform to American Waterworks Association Standards B701, B702 and B703 respectively. Fluoride chemicals shall meet the requirements of chemical additives in R.61-58.2(E)(3). The proposed method of fluoride feed shall be approved by the Department prior to preparation of final plans and specifications.

(a) Fluoride Compound Storage - Dry chemical storage shall be designed in accordance with R.61-58.2(E)(2)(e). Storage units for hydrofluorosilic acid shall be isolated from operating areas and shall be vented to the atmosphere at a point outside any building.

(b) Injection Point - The fluoride compound shall not be added before ion exchange softening or before lime addition, to avoid precipitation of fluoride.

(c) Chemical Feed Installations - Fluoride feed systems shall meet the following criteria:

(i) Scales or loss-of-weight recorders for weighing the quantity of chemicals added shall be provided;

(ii) Feed equipment shall have an accuracy to within five (5) percent of any desired feed rate;

(iii) The point of application of hydrofluorosilic acid, if into a pipe, shall be in the lower half of the pipe and project upward at an angle approximately forty (40) degrees and extend into the pipe one-third of diameter; and,

(iv) All fluoride feed lines shall be provided with adequate antisiphon devices.

(v) All fluoride feed systems shall be equipped with a fail-safe system to prevent the continued feed of fluoride at times when there is no flow of water through the fluoride feed point.

(d) Protective equipment - At least one (1) pair of rubber gloves, a respirator of a type certified by the National Institute for Occupational Safety and Health for toxic dusts or acid gas (as necessary), an apron or other protective clothing, and goggles or face masks shall be provided for use by the operator. Other protective equipment may be re- quired, as deemed necessary by the Department.

(e) Dust Control

(i) Provisions shall be made for the transfer of dry fluoride compounds from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of fluoride dust which may enter the room in which the equipment is installed. The enclosure shall be provided with an exhaust fan and dust filter to the outside atmosphere of the building.

(ii) Provisions shall be made for disposing of empty bags, drums and barrels in a manner which will minimize exposure to fluoride dusts. A floor drain shall be provided to facilitate the washing of floors.

(8) Corrosion Control - Water that is corrosive due either to natural causes or to treatment given the water shall be rendered non-corrosive, and nonaggressive before being pumped to the distribution system.

(a) Alkali Feed - Corrosive water due to natural occurrence, or chemical exchange process shall be treated by an alkali feed. Alkali feed can consist of lime, soda ash, bicarbonate, caustic soda, or a combination of any of the above. Lime feed systems shall include a mechanism for flushing the feed lines, including suction and pumping equipment, if used.

(b) Phosphates - The feeding of phosphates may be applicable for corrosion control. Phosphate chemicals shall meet the requirements of chemical additives in R.61- 58.2(E)(3).

(c) Carbon dioxide addition

(i) Recarbonation basin design shall provide:

(A) A total detention time of at least twenty (20) minutes.

(B) A minimum of two (2) compartments, consisting of a mixing compartment having a detention time of at least three (3) minutes, and a reaction compartment.

(ii) Carbon dioxide feed systems shall be isolated from the operating area and adequate precautions shall be taken to prevent the possibility of carbon monoxide entering the plant from recarbonation compartments.

(iii) Provisions shall be made for draining the recarbonation basin and removing sludge.

(d) Other Treatment - Other treatment for controlling corrosive waters will be considered on a case by case basis. All chemicals must meet the requirements in R.61- 58.2(E)(3). Any proprietary compound must receive the specific approval of the Department before use.

(e) Control - Laboratory equipment, acceptable to the Department, shall be provided to test the compounds being fed.

(9) Taste and Odor Control - When necessary, provision shall be made for the addition of taste and odor control chemicals. These chemicals shall be added sufficiently ahead of other treatment processes to ensure adequate contact time for an effective and economical use of the chemicals.

(a) Flexibility - Plants treating water that is known to have taste and odor problems shall be provided with equipment that makes several of the control processes available to allow the operator flexibility in operation.

(b) Chlorination - Chlorination can be used for the removal of some objectionable odors. Adequate contact time must be provided to complete the chemical reactions involved. Consideration shall be given to the formation of disinfection by-products if this method is used.

(c) Chlorine Dioxide - Chlorine dioxide may be used in the treatment of taste or odor. Provision shall be made for the proper storing and handling of sodium chlorite, so as to eliminate any danger of explosion. Consideration shall be given to the formation of disinfection by-products if this method is used.

(d) Granular Activated Carbon Absorption Units - Rates of flow shall be consistent with the type and intensity of the problem. The rate used shall be supported by the results of pilot plant studies and shall be in accordance with the requirements of R.61- 58.2(D)(1).

(e) Aeration - Aeration units used for taste and odor removal shall be designed in accordance with R.61-58.2(D)(5).

(f) Potassium Permanganate - The application of potassium permanganate may be considered, provided that dosages are determined by permanganate demand testing.

(10) Membrane Technology - All applications for projects involving membrane technology must be preceded by an engineering report and may require a pilot study.

(a) Reverse Osmosis

(i) Pilot Study - The pilot study, where required, must determine or address the following items:

(A) Membrane loading rates including the most efficient percentage of recovery;

(B) What pre-treatment is needed including feed rates of any chemicals;

(C) Whether by-pass blending can be used and what the blending rate will be;

(D) The post treatment needs including what chemical additions will be necessary to make the finished water non-corrosive; and,

(E) The best type of membrane for the source water application.

(ii) General Design Requirements -

(A) A flow meter with totalizer must be provided for the permeate and the blend lines in each treatment train.

(B) Valves must be provided on the influent, permeate, reject, and cleaning lines for each unit.

(C) Pressure gauges must be provided on the influent and permeate lines for each unit for measurement of head loss.

(D) Sample taps must be provided for the permeate, blended product, and finished water.

(E) Monitoring equipment must be provided to measure pH, conductivity, temperature, turbidity, and any specific contaminants for which treatment is being provided.

(F) Disposal of concentrate and cleaning solutions must be approved by the Department.

(iii) Reverse Osmosis Membrane Material -

(A) Membrane material used in public water systems shall be certified as meeting the specification of the American National Standards Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

(B) Loading rates must be determined by pilot testing and manufacturers recommendations.

(iv) Scale Inhibitors and Cleaning Solutions - Scale inhibitors and cleaning solutions must meet the requirements of chemical additives in R.61-58.2(E)(3).

(v) Post-Treatment -

(A) Continuous disinfection must be employed on the permeate or on the blended effluent from the treatment units.

(B) Treatment shall be employed to render the finished water non-corrosive.

(b) Electrodialysis Reversal - Electrodialysis reversal treatment shall not be used on surface water or groundwater under the direct influence of surface water unless the requirements of R.61-58.10 are otherwise met.

(i) Pretreatment - Pretreatment must be used to protect the membrane from fouling. Media filtration used in pretreatment must be designed in accordance with R.61-58.2(D)(1). Degassification must be designed in accordance with R.61-58.2(D)(5).

(ii) Pilot Study - The pilot study must determine or address the following items:

(A) Membrane loading rates including the most efficient percentage of recovery;

(B) What pre-treatment is needed including feed rates of any chemicals;

(C) Whether by-pass blending can be used and what the blending rate will be;

(D) The post treatment needs, including what chemical additions will be necessary to make the finished water non-corrosive; and,

(E) The best type of membrane for the source water application.

(iii) General Design Requirements -

(A) A gallon meter with totalizer must be provided for the product water and the blend lines in each treatment train.

(B) Valves must be provided on the influent, product water, reject, and cleaning lines for each unit.

(C) Electric volt and current meters must be provided to measure the electric potential across each unit.

(D) Pressure gauges must be provided on the influent and product lines for each unit for measurement of head loss.

(E) Sample taps must be provided for the product, blended water, and finished water.

(F) Monitoring equipment must be provided to measure pH, conductivity, temperature, turbidity, and any specific contaminants for which treatment is being provided.

(G) Disposal of concentrate and cleaning solutions must be approved by the Department.

(iv) Electrodialysis Reversal Membrane Material -

(A) Membrane material used in public water systems shall be certified as meeting the specification of the American National Standard Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

(B) Loading rates must be determined by pilot testing and manufacturers recommendations.

(v) Scale Inhibitors and Cleaning Solutions - Scale inhibitors and cleaning solutions must meet the requirements of chemical additives in R.61-58.2(E)(3).

(vi) Post-Treatment -

(A) Continuous disinfection must be employed on the product water or on the blended effluent from the treatment units.

(B) Treatment shall be employed to render the finished water non-corrosive.

E. Chemical Application.

(1) General - No chemical shall be applied to treat drinking waters unless specifically permitted by the Department. A certified operator is required whenever the chemical or physical characteristics of the water is changed.

(a) Plans and specifications - Plans and specifications shall be submitted for review and approval, as required by in R.61-58.1, and shall include:

(i) Descriptions of feed equipment, including maximum and minimum feed ranges and pump curves for solution feeders,

(ii) Location of feeders, piping layout and points of chemical application,

(iii) Storage and handling facilities;

(iv) Specification for chemicals to be used;

(v) Operating and control procedures including proposed application rates;

(vi) Descriptions of testing equipment and procedures; and,

(vii) Locations of sampling taps for testing.

(b) Chemical application - Chemicals shall be applied to the water at such points and by such means as to:

(i) Provide maximum efficiency of treatment;

(ii) Ensure maximum safety to consumer;

(iii) Provide maximum safety to operators;

(iv) Ensure satisfactory mixing of the chemicals with the water;

(v) Provide maximum flexibility of operation through various points of application, when appropriate;

(vi) Prevent backflow or back-siphonage between multiple points of feed through the use of separate feed equipment for each point and backflow preventers where a manifold system is used for standby, multiple feed use;

(vii) Not be located upstream of the metering device when the chemical in consideration will interfere with the flow measurement;

(viii) Provide a separate injection point and a separate feed line for each chemical application that is added and, spacing to prevent inter-reaction of chemicals; and,

(ix) Provide chemical injection points which are readily accessible. All below-grade injection points shall be housed in a vault or similar structure.

(c) General equipment design - General equipment design shall be such that:

(i) Chemical-contact materials and surfaces are corrosion resistant;

(ii) Corrosive chemicals are introduced in such a manner as to minimize potential for corrosion; and,

(iii) Chemicals that are incompatible are not fed, stored or handled together.

(2) Facility Design

(a) Chemical feeders -

(i) A separate feeder shall be used for each separate chemical applied, and for each injection point.

(ii) Spare parts shall be available for all feeders to replace parts which are subject to wear and damage.

(iii) Dry chemical feeders shall:

(A) Measure chemicals volumetrically or gravimetrically;

(B) Provide adequate solution water and agitation of the chemical in the solution pot;

(C) Provide gravity feed from solution pots; and,

(D) Completely enclose chemicals to prevent emission of dust to the operating room.

(iv) Chemical feed equipment, where necessary, shall be located in a separate room to reduce hazards and dust problems; shall be conveniently located near points of application to minimize length of feed lines; and, shall be readily accessible for servicing, repair, and observation of operation.

(v) Feeders shall be able to supply, at all times, the necessary amounts of chemicals at an accurate rate;

(b) Control -

(i) Feeders with automatic controls shall be designed so as to allow override by manual controls.

(ii) Chemical feed rates shall be proportional to flow.

(iii) Meters, scales, calibration columns, or other acceptable means to measure chemicals being fed must be provided in order to determine chemical feed rates.

(iv) Provisions shall be made for measuring the quantities of chemicals used.

(c) Cross-connection control -

(i) Cross-connection control shall be provided to ensure that liquid chemical solutions cannot be siphoned through solution feeders into the water supply.

(ii) The service water lines discharging to the solution tanks shall be properly protected from backflow as required by the Department.

(iii) No direct connection shall exist between any sewer and a drain or overflow from the feeder, solution chamber or tank. All drains shall terminate at least six (6) inches or two (2) pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle.

(d) Service water supply shall be ample in supply and adequate in pressure; shall be provided with means for measurement when preparing specific solution concentrations by dilution; shall be properly treated potable water; and shall be properly protected against backflow.

(e) Storage of chemicals -

(i) Space shall be provided for at least three (3) days of chemical supply and provide for convenient, efficient and safe handling of chemicals. Dry storage conditions must be maintained for dry chemicals.

(ii) Storage tanks and pipelines for liquid chemicals shall be designed specifically for each chemical used.

(iii) Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved covered storage unit.

(f) Solution tanks -

(i) A means which is consistent with the nature of the chemical solution shall be provided in a solution tank to maintain a uniform strength of solution. Continuous agitation shall be provided to maintain slurries in suspension.

(ii) Means shall be provided to measure the solution level in the tank.

(iii) Chemical solutions shall be kept covered. Large tanks with access openings shall have such openings curbed and fitted with tight overhanging covers.

(iv) Overflow pipes, when provided, shall:

(A) Be turned downward, with the end screened;

(B) Have an air gap of two (2) pipe diameters or six (6) inches, whichever is greater; and,

(C) Be located where noticeable.

(v) Acid storage tanks shall be vented independently to the outside atmosphere.

(vi) Each tank shall be provided with a valved drain, protected against backflow in accordance with R.61-58.2(E)(2)(c)(iii).

(g) Feed lines -

(i) Feed lines shall be as short as possible in length of run, and of durable, corrosion resistant material. They shall be easily accessible throughout the entire length, protected against freezing, and readily cleanable;

(ii) Feed lines shall be designed consistent with scale-forming or solids depositing properties of the water, chemical, solution or mixture conveyed;

(iii) Feed lines shall be color coded and labeled; and,

(iv) Where lime is added, a spare feed line equal in length to the longest run of feed line, shall be provided.

(h) Handling -

(i) Provisions shall be made for disposing of empty bags, drums or barrels by an approved procedure which will minimize exposure to dust.

(ii) Provision shall be made for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers, in such a way as to minimize the quantity of dust which may enter the room in which the equipment is installed.

(iii) Provision shall be made for measuring quantities of chemicals used to prepare feed solutions.

(i) Housing -

(i) Floor surfaces shall be smooth, impervious, slip-proof and well-drained.

(ii) Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes.

(iii) Feeders used in conjunction with dry lime or carbon shall be housed in separate, individual rooms equipped with dust control systems.

(iv) Sufficient lighting for operator safety and sufficient heating to provide for proper operation of the chemical feed equipment shall be provided for all chemical feed rooms.

(3) Chemicals Specifications - All chemicals and products added to a public water supply as part of the treatment process shall be certified as meeting the specifications of the American National Standards Institute/National Sanitation Foundation Standard 60, Drinking Water Treatment Chemicals - Health Effects. The certifying party shall be accredited by the American National Standards Institute.

F. Waste Handling and Disposal.

Waste handling and disposal practices shall meet all applicable rules and regulations of the Department. Provisions must be made for proper disposal of treatment waste such as iron sludge, filter backwash water, and brine waste. In locating waste disposal facilities, due consideration shall be given to preventing potential contamination of the water supply. For projects involving a surface water discharge of treatment residuals, a National Pollutant Discharge Elimination System (NPDES) permit must be obtained from the Department. For projects involving land application of treatment residuals, a No Discharge (ND) permit must be obtained from the Department.